

REMARKS

Applicant appreciates the thoroughness with which the Examiner has examined the above-identified application. Reconsideration is requested in view of the amendments above and the remarks below.

Specification objections

Applicant has made the amendments to paragraphs [0005], [0013], [0022] and [0028] as suggested by the Examiner, and to correct grammatical errors.

With regard to the remaining suggested amendments to the specification, applicant has previously amended the specification in paragraph [0024] to refer to the "substrate" as having base 20 overlaid with phase shifting material 22 and opaque material 24. This is in conformance with the language used in original paragraph [0011] and in the claims and clarifies any ambiguity that might have existed previously. Additionally, applicant's previous amendment does not necessitate the incorporation of the term "blank," which has not been previously used in the application. Accordingly, it is believed that no further amendments to the specification are necessary with regard to the term "substrate."

No new matter has been added by these amendments.

Rejection under 35 USC § 112, first paragraph

Claims 1-20 stand rejected for not enabling one to make "embedded" attenuated phase shift masks (EAPSMs). However, as is well known, the term "embedded" refers to the incorporation of an opaque layer, such as chromium, in the mask along with the phase shifting material. This is explained in the specification at paragraph [0005], wherein it is stated:

Other PSMs for example, embedded attenuated phase shift masks (EAPSMs), utilize opaque layers of chromium to mask non-critical areas outside of the critical structure areas.

As for the Examiner's question as to "how" the EAPSMs are made embedded, the formation and incorporation of opaque layers such as chromium with layers of phase shifting material is described throughout the specification and drawings. Additionally, the lithographic techniques described therein are generally well known, apart from the inventive aspects of the present invention. Accordingly, applicant submits that the term "embedded attenuated phase shift masks" is fully enabled in the application.

Rejection under 35 USC § 112, second paragraph

Applicants have amended independent claims 1, 12 and 18 to recite the step of "depositing a second resist layer on the substrate having first level phase shifting image segments" and "etching the critical structure areas to remove the opaque material therefrom," as suggested by the Examiner.

With regard to the remaining suggested amendments to claims 1, 12 and 18, applicant has previously amended the specification in paragraph [0024] to refer to the "substrate" as having base 20 overlaid with phase shifting material 22 and opaque material 24. This is in conformance with the language used in original paragraph [0011] and in the claims and clarifies any ambiguity that might have existed previously. Additionally, applicant's previous amendment does not necessitate the incorporation of the term "blank," which has not been previously used in the application.

With respect to the Examiner's suggestion to add the phrase "to finish the EAPSM," applicant submits that the claims sufficiently describe the novel and unobvious steps of how to make an EAPSM. The claims utilize the open-ended

transition phrase "comprising," and any addition of the suggested phrase would unduly limit the scope of the claim.

Accordingly, it is believed that no further claim amendments are necessary to comply with 35 USC § 112, second paragraph.

Rejection under 35 USC § 103

Claims 1 and 3 stand rejected under 35 USC § 103 as being obvious from Tzu U.S. Patent No. 6,423,455 in view of Moon et al. U.S. Patent No. 5,741,613.

Claims 2 and 12 stand rejected under 35 USC § 103 as being obvious from either Tzu and Moon together or additionally in view of Glendinning U.S. Patent No. 4,797,334.

Claims 4, 8 and 9 stand rejected under 35 USC § 103 as being obvious from Tzu or Moon in view of either Chiang U.S. Patent No. 4,343,877 or Irie U.S. Patent No. 6,710,847.

Claims 5, 6 and 7 stand rejected under 35 USC § 103 as being obvious from Tzu and Moon in view of either Chiang or Irie and further in view of Aita U.S. Patent No. 5,405,734.

Claims 10 and 11 stand rejected under 35 USC § 103 as being obvious from Tzu and Moon in view of either Narushima U.S. Patent No. 6,549,277 or Inao U.S. Patent Publication No. US 2001/0036581.

Claims 13, 15, 18 and 20 stand rejected under 35 USC § 103 as being obvious from Tzu and Moon together or additionally in view of Glendinning, and further in view of either Chiang or Irie.

Applicant respectfully traverses these rejections.

Applicant has amended claims 1 and 12 to recite that the claimed method further includes: 1) marking the single frame exposure mask with an identification corresponding to the EAPSM or corresponding to chip or field size of the EAPSM; 2) storing the single frame exposure mask in a mask library for future use; 3) obtaining the single frame exposure mask from the mask library; and 4) using the single frame exposure mask to repair or remanufacture the EAPSM. Support is found in the specification in paragraphs [0013] and [0030], and in original claims 4 and 13. Claim 12 has also been amended to incorporate the subject matter of claim 15. Dependent claims 4, 13 and 15 have accordingly been cancelled, and the subsequent dependent claims have been amended to depend on either claim 1 or claim 12. No new matter has been added.

Claim 1

Claim 1 of the present invention is directed to a method of making an embedded attenuated phase shift mask (EAPSM) that creates first level phase shifting image segments on a substrate corresponding to areas of critical structures to be exposed, and which employs a single frame exposure mask corresponding to non-critical areas outside the critical structure areas. The substrate has a layer of phase shifting material and a layer of an opaque material. The method uses a first resist layer on the substrate to create first level phase shifting image segments on the substrate corresponding to areas of critical structures to be exposed with the EAPSM. The method then deposits a second resist layer on the substrate and uses the single frame exposure mask to expose and develop the second resist layer. The method includes etching the substrate to remove the opaque material from the critical structure areas. As amended, the method then further includes marking the single frame exposure mask

with an identification corresponding to the EAPSM or corresponding to chip or field size of the EAPSM; storing the single frame exposure mask in a mask library for future use; obtaining the single frame exposure mask from the mask library; and using the single frame exposure mask to repair or remanufacture the EAPSM. As described in the specification at paragraph [0030], the present invention permits one single frame exposure mask to be use multiple times in the even that the EAPSM is reworked, damaged or redesigned.

The Tzu patent

The Tzu patent cited by the Examiner does not distinguish between portions of the phase shift mask substrate used for critical structures and those portions corresponding to non-critical areas outside the critical structures areas. Tzu discloses only the use of one resist layer (26) to create the phase shifting mask, and does not employ a second resist layer. The Tzu patent does not disclose the use of a single frame exposure mask, corresponding to non-critical areas outside the critical structure areas, to expose a second resist layer to ultimately remove the opaque material from the critical structure areas.

The Examiner takes the position that Tzu discloses a "second patterned resist layer portions (26a', 26b', 26c', and 26d', noting the intentional use of a 'prime' added to each of these second resist layer portions to distinguish them from the first resist layer portions)" Office Action, p.7. However, the "prime" added to patterned photoresist layers 26a, 26b, 26c and 26d actually denotes that the resist layers 26a, 26b, 26c and 26d have been *irradiated*. See, Tzu, column 8, lines 7-8. The Examiner acknowledges the absence of such teaching in stating "Tzu does not specifically teach deposition of the second resist layer for the second patterning step after removal of a

patterned first resist layer that was previously used in a first patterning step." Office Action, p. 8. Thus, Tzu does not disclose any deposition of a second resist layer as recited in claim 1.

More importantly, however, the Tzu patent does not disclose or suggest the marking, storing or re-use of the single frame exposure mask to repair or remanufacture the EAPSM. Tzu mentions only a "cutout mask 28a and 28b" that is either a "separate mask employed within the photoexposure apparatus" or "a set of blades" See Tzu, column 8, lines 47-60. This does not suggest applicant's claimed identified, library-stored and re-used single frame exposure mask.

The Moon patent

Moon is directed to forming half-tone phase shift masks using two different photoresist layers. Moon states that "[t]he second layer 39 of photoresist is then patterned to form a second mask 39a." Moon, column 4, lines 40-42. There is no disclosure in Moon of using a "single frame exposure mask corresponding to non-critical areas outside the critical structure areas" to expose the second resist layer, as in applicant's claims 1, 12 and 18. There is also no suggestion in either Moon or Tzu as to discarding Tzu's one-resist method and using Moon's two-resist method with applicant's claimed "single frame exposure mask." Since Moon discloses no mask, there is no suggestion of the identification, storage and re-use of applicant's claimed "single frame exposure mask."

The Chiang patent

The Chiang patent is cited by the Examiner for teaching "the production and use of improved masks having various types of identification (ID) codes to identify individual masks in a mask set, as well as (corresponding) ID codes printed on each

wafer chip to make integrated circuit devices" Office Action, pp.10-11. However, the Chiang patent is only directed to a method of identifying masks for the production of integrated circuits themselves, and not for the production of EAPSMs as in the present invention. The Chiang masks are not single frame exposure masks as applicant has defined, since they do not correspond to non-critical areas outside the critical structure areas of the EAPSM in which the phase shifting image segments are located. Chiang's masks further are not marked with any identification corresponding to the EAPSM or corresponding to chip or field size of the EAPSM, and are not used to repair or remanufacture the EAPSM, as recited in claim 1.

One of ordinary skill in the art would not find in the Tzu or Moon references any teaching, motivation or suggestion to combine the references in a manner that discards Tzu's one-resist layer manufacturing method in favor of Moon's two-resist layer method, while at the same time keeping Tzu's mask and discarding Moon's no-mask method. See, *In re Lee*, 277 F.3d 1338, 61 USPQ2d 1430, 1433 (Fed. Cir. 2002). It is improper to use applicant's own specification in hindsight as motivation to subjectively reconstruct applicant's claimed invention. See, *W.L. Gore v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303, 312-13 (Fed. Cir. 1983). Thus, applicant submits that there is no prima facie obviousness based on Tzu and Moon.

The hypothetical combination of Chiang's disclosure of integrated circuit photolithography mask identification also would not render the present invention obvious since it does not disclose or suggest applicant's claimed identification, storage and reuse of EAPSM masks based on identification corresponding to the EAPSM or corresponding to chip or field size of the EAPSM. Chiang simply does not touch on or suggest the use of the system therein in connection with single frame exposure masks

corresponding to non-critical areas outside the critical structure areas of the EAPSM carrying phase shifting image segments. Thus, applicant's invention as defined in claim 1 is not obvious under 35 USC § 103.

Claims 5, 6 and 7

Claims 5, 6 and 7, dependent on claim 1, specify that the single frame exposure mask is used to remanufacture the EAPSM where the EAPSM is reworked, damaged or redesigned, respectively.

The Examiner acknowledges that neither Tzu, Moon, Chiang or Irie disclose such remanufacture using the single frame exposure mask in applicant's claimed invention, and cites Aita for such subject matter. However, Aita uses no single frame exposure mask to repair any type of lithographic mask, let alone an EAPSM. Instead, Aita uses a focused ion beam (1) to remove excess patterning film. Therefore, in addition to the reasons given in connection with claim 1, one of ordinary skill would not consider obvious applicant's invention as defined in claims 5, 6 and 7 from the addition of Aita.

Claim 12

Independent claim 12 includes the limitations of claim 1, and has been similarly amended, in the manner discussed with respect to claim 1, to add to the method the marking, storing, obtaining and re-using of the mask to repair or remanufacture the EAPSM. Claim 12 also now specifies that the single frame exposure mask is stored in a mask library for future use with other EAPSMs in the same mask set as the EAPSM, or with other EAPSMs having the same chip or field size as the EAPSM.

In addition to being deficient for the reasons given above in connection with claim 1, the Tzu, Moon and Chiang patents do not disclose or suggest that a single

frame exposure mask marked with an identification may be stored in a mask library with one or more EAPSMs. Moon says nothing about masks at all, and Tzu says nothing about mask storage. Chiang discusses a "photomask set" throughout the patent, but does not suggest that the photomask set be stored along with the devices to be manufactured by the photomask set. Applicant's method as defined by claim 12 includes the storage of the single frame exposure mask in a mask library along with the EAPSMs to be manufactured by the single frame exposure mask. As stated in the specification at paragraph [0030], this permits ready repair or remanufacture of the EAPSM(s) to which the single frame exposure mask corresponds.

Accordingly, applicant submits that claim 12 is not obvious from the hypothetical combination of Tzu, Moon and Chiang.

Claim 18

Claim 18 recites that the single frame exposure mask is identified and stored for future use with the EAPSM in the same mask set as the EAPSM, or with other EAPSMs having the same chip or field size as the EAPSM. This storage is not disclosed in Chiang or the other cited references, as discussed above in connection with claim 12, and claim 18 is likewise not obvious to one of ordinary skill in the art..

Claims 14 and 19

Claims 14 and 19 both combine the subject matter of claims 5, 6 and 7, and are dependent on claims 13 and 18, respectively. They are not obvious for the same reasons as given in connection with claims 5, 6, 7, 13 and 18.

It is respectfully submitted that the application has now been brought into a condition where allowance of the entire case is proper. Reconsideration and issuance of a notice of allowance are respectfully solicited.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Peter W. Peterson', written over a horizontal line.

Peter W. Peterson
Reg. No. 31,867

DeLIO & PETERSON, LLC
121 Whitney Avenue
New Haven, CT 06510-1241
(203) 787-0595